PRÉCIS

INFRASTRUCTURE AND A WARMING ARCTIC

Background

This précis provides an overview of the highlights from the fall 2004 report "Impacts of a Warming Arctic[1]". The report was commissioned by the Arctic Council, an international body composed of eight Arctic nations (including Canada), six indigenous peoples, several observer states[2], and a variety of scientific and non-governmental organizations.

The report itself is a synthesis of the findings of the Arctic Climate Impact Assessment (ACIA). The ACIA was conducted over a four-year period beginning in 2000, involving the research of over 250 scientists and the input of traditional knowledge to determine the currently observed and potential impacts of climate change in the Arctic. The methodologies ranged from field and laboratory experiments, to observed trends, theoretical analyses, and model simulations. All predictions of future climate change in the report are based on conservative estimates, representing neither the best nor worst case scenarios.

Overview

"Impacts of a Warming Arctic" includes an examination of the impacts climate change will have on northern infrastructure, and alludes to the role national infrastructure plays in containing or accelerating climate change. The data suggests that human influences such as pollution and habitat destruction have increased the rate of climate change in the Arctic over the last fifty years. There is thus a need for both nation-wide "green" infrastructure to reduce pollution, and a strategy to respond to imminent infrastructure degradation in the north.

The 4 million people currently inhabiting the Arctic are witnessing the early impacts of these changes, and will experience some of the most severe expected impacts of climate change in years to come. The major changes predicted in the ACIA include: rapid warming of the Arctic climate (4-7 degree increase over the next 100 years), shifting of vegetation zones, changing animal species diversity and range of distribution, increased coastal storms, reduced sea ice, elevated ultraviolet radiation, and thawing ground. These changes will have major cultural and economic impacts on indigenous people in the Arctic. They will also have global implications for sea levels, ocean currents, greenhouse gases, climate and biodiversity.

The report identifies three areas where further study is necessary: sub-regional impacts, socioeconomic impacts, and assessing vulnerabilities. This can be accomplished with long-term monitoring, process studies, modeling, and analysis of impacts on society. The report also recommends two sets of actions to respond to climate change: mitigation, or actions to control current and future emissions and curb the development

[1] ACIA, Impacts of a Warming Arctic: Arctic Climate Impact Assessment. Cambridge University Press. 2004.

[2] Observer states include France, the Netherlands, the United Kingdom, Germany and Poland.

of climate change; and adaptation, or actions to handle the imminent changes that will come as a result of past emissions.

Impacts in Canada

"Impacts of a Warming Arctic" recognizes that the effects of climate change are not experienced uniformly across the Arctic. Correspondingly, it divides the Arctic into four sub-regions based on atmospheric circulation patterns, two of which include Canada.

In the Western Canadian Arctic (Yukon), average annual temperature has risen 2-3 degrees Celcius over the last 50 years, and is projected to increase by an additional 4-7 degrees by the 22nd century. This will push forest expansion north beyond the current tree line, increasing the potential for forest fires and bogs. The increase in temperature will allow the expansion of habitats to the north, bringing new species that will threaten the existing biodiversity of the region. Rising temperatures will result in melting sea ice, which is expected to lead to stronger and more frequent coastal storms. These storms could result in increased coastal erosion and threaten human settlements and infrastructure.

In the Central and Eastern Canadian Arctic (Northwest Territories and Nunavut), average annual temperature has risen by 1-2 degrees Celsius over the last 50 years, and is projected to increase by another 3-5 degrees by the 22nd century. A major issue facing this region is the decline of sea ice, particularly the "fast ice"[3] in the Northwest Passage and the Greenland ice sheet. While this will contribute to coastal erosion, it will also increase the opportunity for shipping through the Northern Sea Route, which represents up to 40% cost savings in shipments from northern Europe to northeastern Asia. This will raise new issues in governance and security. The region may also experience thawing permafrost[4] that will destabilize the ground and jeopardize pipelines, pile foundations, bridges, housing, dikes, and erosion protection structures. In spite of a longer construction season courtesy of warmer temperatures, the thawing ground will have primarily negative and destructive effects on construction and infrastructure for at least the next 100 years.

Implications for Infrastructure

The report argues that changes in the Arctic climate will have serious consequences for northern infrastructure. The melting of sea ice, shortened freezing period for lakes and rivers, the decline of permafrost, and an increased frequency of natural disasters will have destructive impacts on coastal facilities, northern transportation routes, bridges, buildings and sewer/water systems in the Arctic.

Over the past few decades the amount of sea ice across the Arctic has decreased by 10 to 15 percent. The reduced ice has resulted in stronger winds and larger ocean waves, which contact the shoreline with greater force causing faster erosion. This poses serious problems for ports, tanker terminals, industrial facilities, and coastal villages. Efforts to stem the effects of coastal erosion via man-made barriers have been largely ineffective. For example, in the Alaskan village of Nelson Lagoon and the Canadian port town of

[3] Ice that grows from the coast into the sea, remaining attached to the coast or a shallow sea floor.
[4] Ground which is frozen year-round.

Tuktoyuktuk, barriers constructed to slow or stop coastal erosion were quickly destroyed by water and wind, failing to have any significant effect on preserving coastal infrastructure.

In contrast to the destructive effects that melting sea ice will have on coastal infrastructure, it will also increase the need for such facilities. The melting sea ice is expected to open the Northwest Passage for greater shipping, which would increase the demand on northern port facilities.

Rising temperatures will also accelerate the melting of ice over lakes and rivers. This will reduce the availability of ice roads (formalized networks of ploughed corridors over frozen lakes and rivers), which have become an important part of transportation infrastructure and commercial activity in the north.

Another change that impacts infrastructure directly is the thawing of ground permafrost, which affects the stability of underground pipelines, water and sanitation infrastructure, building foundations, railways and airstrips. These effects have already been felt in areas like the Siberian city of Yakutsk, where more than 300 buildings have been damaged by thaw-induced settlement.

In addition to melting ice and thawing ground, natural disasters such as floods, mudslides, rockslides, and avalanches will also impact infrastructure in the Arctic. According to the Arctic Climate Impact Assessment, the frequency of such disasters is likely to increase as the Arctic climate warms.

While long-term climate change has implications for the country's entire infrastructure, there is a pressing concern in the Arctic region. As the report notes however, climate change will not affect all regions of the Arctic uniformly, thus policy should be sensitive to sub-regional local differences.

For the full report see http://amap.no/acia/.